Little Monocacy

Watershed Study

Montgomery County

Department of Environmental Protection

Watershed Management Division

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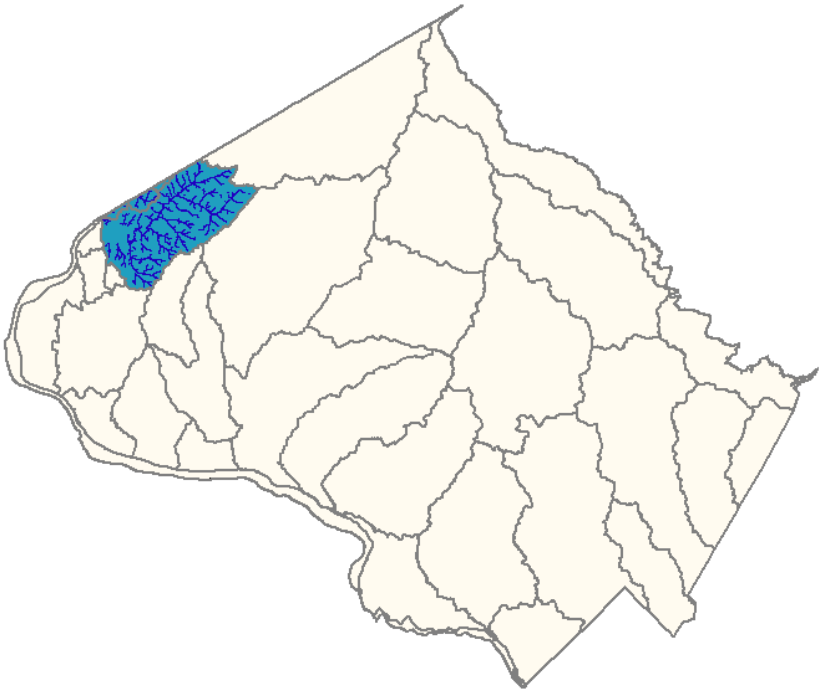

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Executive Summary

The Little Monocacy Watershed is located in the western part of Montgomery County. In the year 2000, Montgomery County's Department of Environmental Protection monitored nine stations to assess stream health, through out the watershed. The following parameters were examined: benthic macroinvertebrates, fish communities, water quality, and quantitative habitat. All the parameters were scored and placed in one of four categories ranging from *poor* to *excellent*. Overall, the Little Monocacy Watershed is in relatively *good* condition. Six stations have *good* habitat, fish, and benthos (LMLM208, 218, 212, 313, 401, 403). One station (LMLM142) showed impairment in the fish community which maybe a result of small drainage area and/or sediment deposition. Station LMLM303 was shown to be an entrenched area with limited fish habitat, and LMLM307 showed large amounts of sediment deposition which appears to have resulted in impairment to the benthic macroinvertebrate communities.

It is recommended that there is further habitat examination at stations LMLM142, LMLM307, and LMLM303 to determine the originating point of the sediment loading, and further evaluation of riparian buffers, and the possibilities for improving fish habitat where needed. No follow up physiochemical monitoring is recommended at this time.

I. Purpose of this Report

The purpose of this report is to:

- Assess the existing stream conditions of Little Monocacy,
- Identify stream reaches with impairment from other than habitat stressors,
- Identify stream reaches with unstable habitat features that, if left alone, could further degrade the biological community of the stream, provide recommendations for follow up actions concerning the identified areas of impaired stream reaches.

II. Introduction to the Watershed (excerpted from the Countywide Stream Protection Strategy)

The Little Monocacy Watershed and the tributaries of the Potomac River are located in the far western area of the County and consist of primarily agricultural and wooded areas. The Little Monocacy River is located almost entirely within Montgomery County and does not flow into the Monocacy River as the name suggests (and many people believe!). The Little Monocacy enters the Potomac River just downstream of where the Monocacy River joins the Potomac River in Frederick County.

The headwaters of the Little Monocacy watershed begin in the rural countryside along Comus Road southwest of the town of Comus. This watershed is one of the most scenic rural watersheds in Montgomery County. Numerous farms maintain the rural nature of this watershed for the full length of the stream system, as many of the County's farms are located in this area. The small towns of Barnesville, Sellman, and Dickerson, all located in this watershed, represent the only concentrated areas of imperviousness in the Little Monocacy. Portions of the Little Monocacy drain Sugarloaf Mountain in Frederick County, with many of the headwater tributaries well forested.

By the time the Little Monocacy passes under Route 28 near the town of Dickerson, it has grown into a wide, rapidly flowing cool water stream. Deep pools and

high velocity riffles help to maintain a diverse cool water fish community here. Nineteen fish species were found here in 1996! Two species of darters were found, greenside darter and fantail darter. Rock bass and bluegills were found in the pools and Silverjaw minnows swam along sandy bottom runs. Large central stonerollers and longnose dace were found in water flowing so fast that the monitoring crew had trouble remaining standing. Baseline monitoring of this watershed will occur in the year 2000. DEP staff also explored the watershed in the spring of 1997 in order to look for least-impaired stream reaches to add to the reference stream inventory.

In the spring, summer, and fall of 2000 County biologists monitored nine monitoring sites within the Little Monocacy Watershed (Figure 1). These stations are located just south of Comus Road and north of West Hunter Road. All nine stations were monitored for benthic macroinvertebrates and eight were monitored for fish. Only four of the nine stations were evaluated during the fall for quantitative habitat analysis.

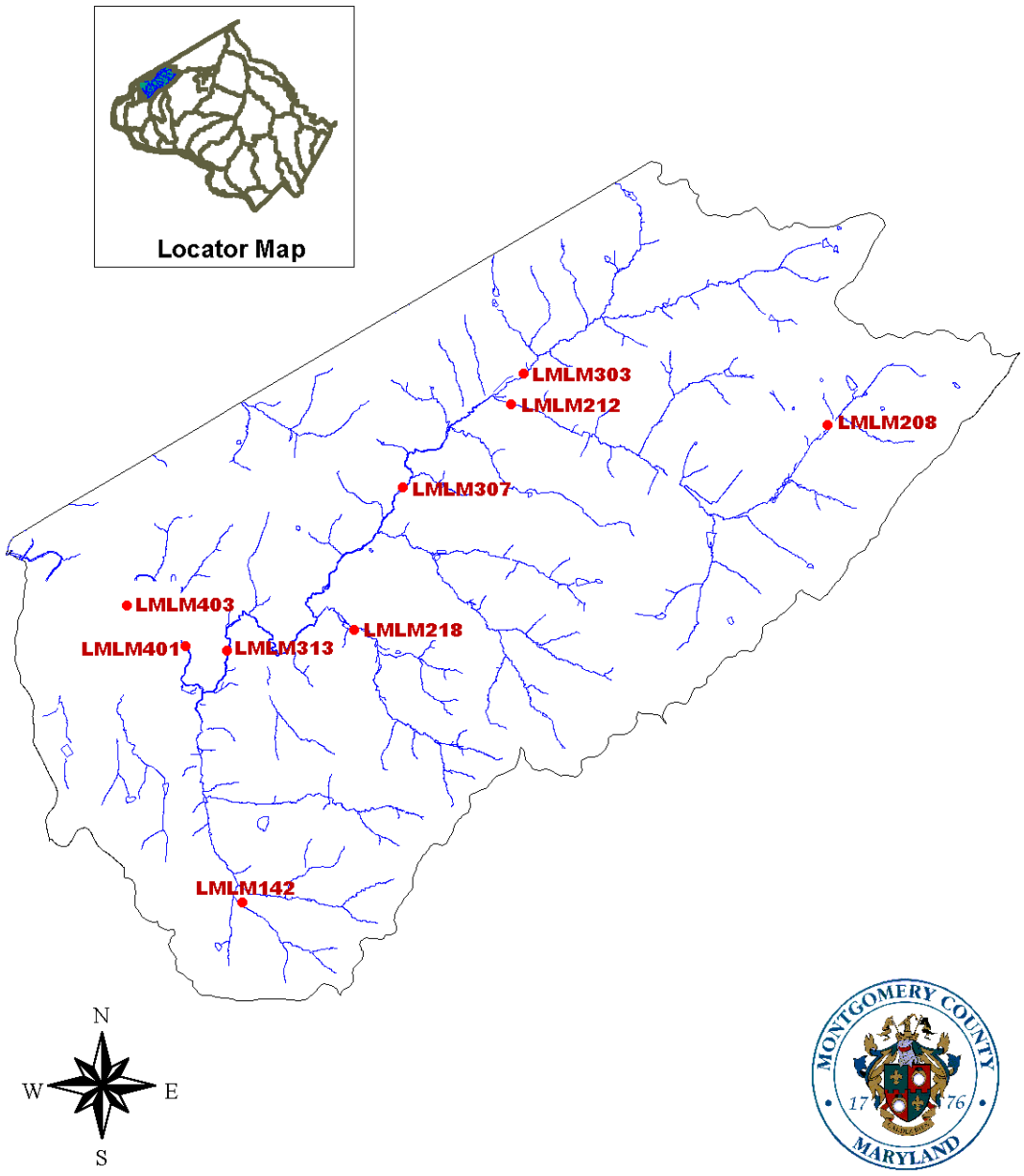


Figure 1. Monitoring Stations for 2000 Monitoring Season

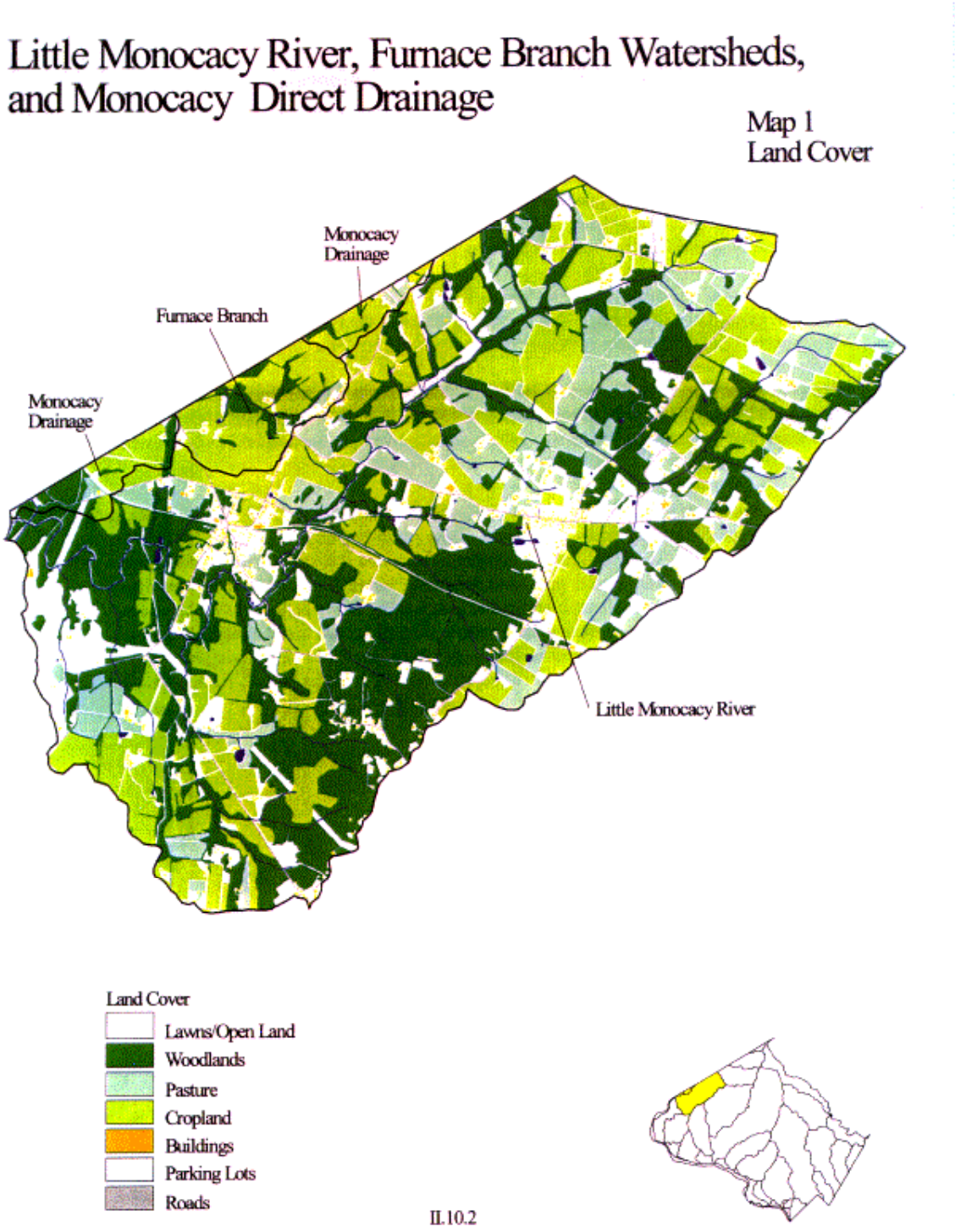


Figure 2. Land Cover for Little Monocacy, Furnace Branch Watersheds, and Monocacy Direct Drainage

III. Methods

All fieldwork, data reduction, and data analysis follow the Montgomery County stream monitoring protocols described in Van Ness et al 1997. The overall stream condition was determined by assessing the cumulative impacts that occurred in the watershed as indicated by the use of an interim Index of Biological Integrity (IBI) for freshwater fish and benthic Macroinvertebrates The stream condition was made by examining the trends expressed by the two IBI's. This is not the same as averaging the two scores. Seasonal trends were examined and a yearly stream condition has been established for the subwatersheds.

Assuming that water quality is constant throughout the study area, the relationship between habitat quality and biological condition can be predictable, (Plafkin et al, 1989), and provide diagnostic information on stressors likely responsible for identified impairment to the existing stream area. Possible causes of impairment can be determined by examining the relationship between the IBI score/habitat score for each individual monitoring station (Figure 1). Percentage of the best attainable biological condition was calculated for each IBI score and compared against percentage of the best attainable instream physical habitat in order to assess relationships between habitat and biology and identify areas of stream impairment from other than physical stressors (Figure 3). The theoretical regression lines shown in Figure 1 describes the general relationship of biological condition to habitat quality in the absence of water quality effects. The highest possible IBI score for fish is 50 (100%), for benthic macroinvertebrates 40 (100%). Abiotic factors such as water temperature, water chemistry, and analysis of both qualitative and quantitative physical habitat attributes are also used to assess the types of stressors that may be affecting the system. Impaired sites are then targeted, and further investigations of the probable causes of impairment are scheduled.

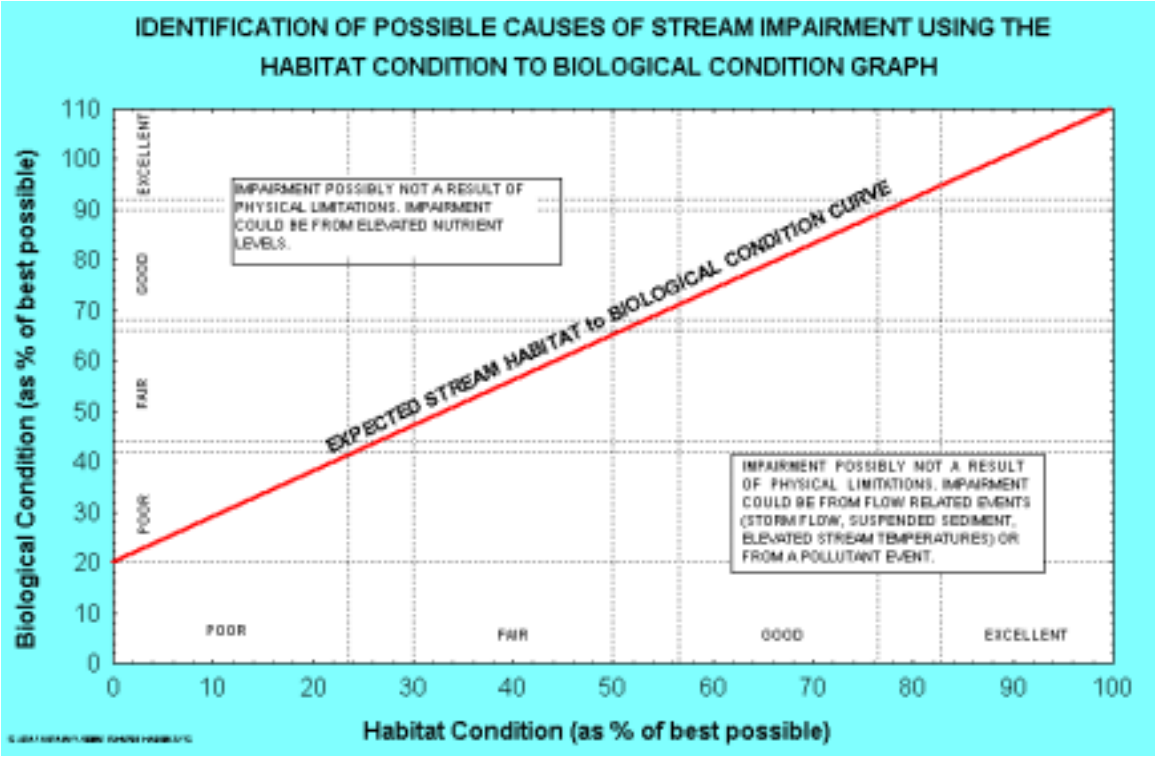


Figure 3. Conceptual Relationship between Habitat and Biological Condition

IV. Results

Stream Condition

Stream conditions for the Little Monocacy watershed were evaluated by monitoring nine sites located south of Comus Road and north of West Hunting Road. LMLM142 is the southern most station, just north of West Hunter Road. LMLM208 is located north of West Old Baltimore Road. LMLM212 and LMLM303 are both east of Harris Road. LMLM218 is east of Big Woods Road. LMLM307 is north of Barnesvillle Road. LMLM313 is east of Dickerson Road, and LMLM401 and LMLM403 are located west of Dickerson Road (Figure 1). All nine stations were monitored for benthic macroinvertebrates and eight were monitored for fish. Four of the nine stations were evaluated during the fall for quantitative habitat analysis. Only one of the sites (LMLM142) was entrenched. Of the eight stations fished, two scored *fair* fish IBI scores, while the other six scored *good.* Each of the eight stations scored *good* for rapid habitat during the fish survey. All stations sampled for benthic macroinvertebrates had *good* IBI scores and rapid habitat scores, with the exception of one station that had a *fair* habitat score (Figure 4).

1. Examination of IBI/Habitat Relationships

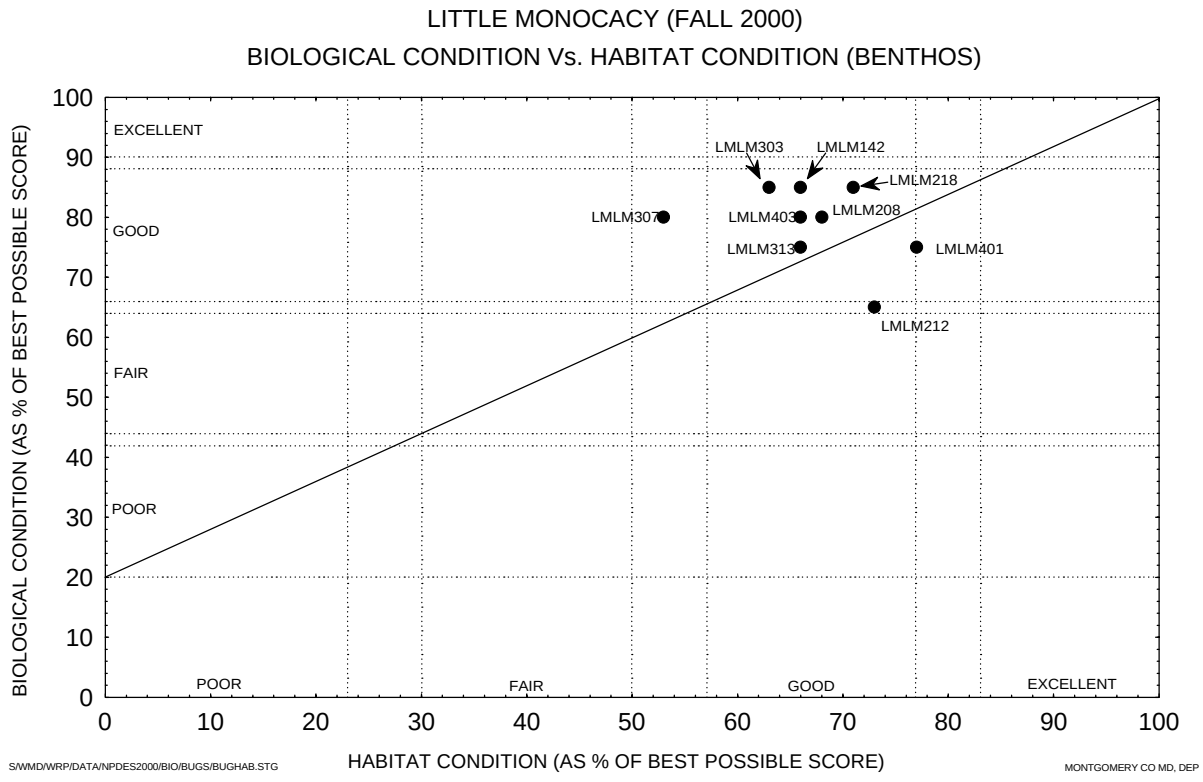
Data from nine monitoring stations were used in the assessment of the Little Monocacy Watershed. Benthic macroinvertebrates were collected in April, and fish surveys were conducted in July-September of 2000.

Fish

One station (LMLM212) had a fish rating of *good*, while its habitat condition scored *excellent* (Figure 4). Five of the stations had fish IBI scores of *good* and rapid habitat scores of *good* (LMLM 208, 218, 307, 313, and 401). LMLM142 and LMLM303 scored *fair* in the fish IBI and *good* in rapid habitat.

Benthic

Eight of the stations had a rating for habitat as *good*, and one station, LMLM307, had a *fair* habitat score (Figure 4). All nine stations scored *good* for benthic macroinvertebrates.



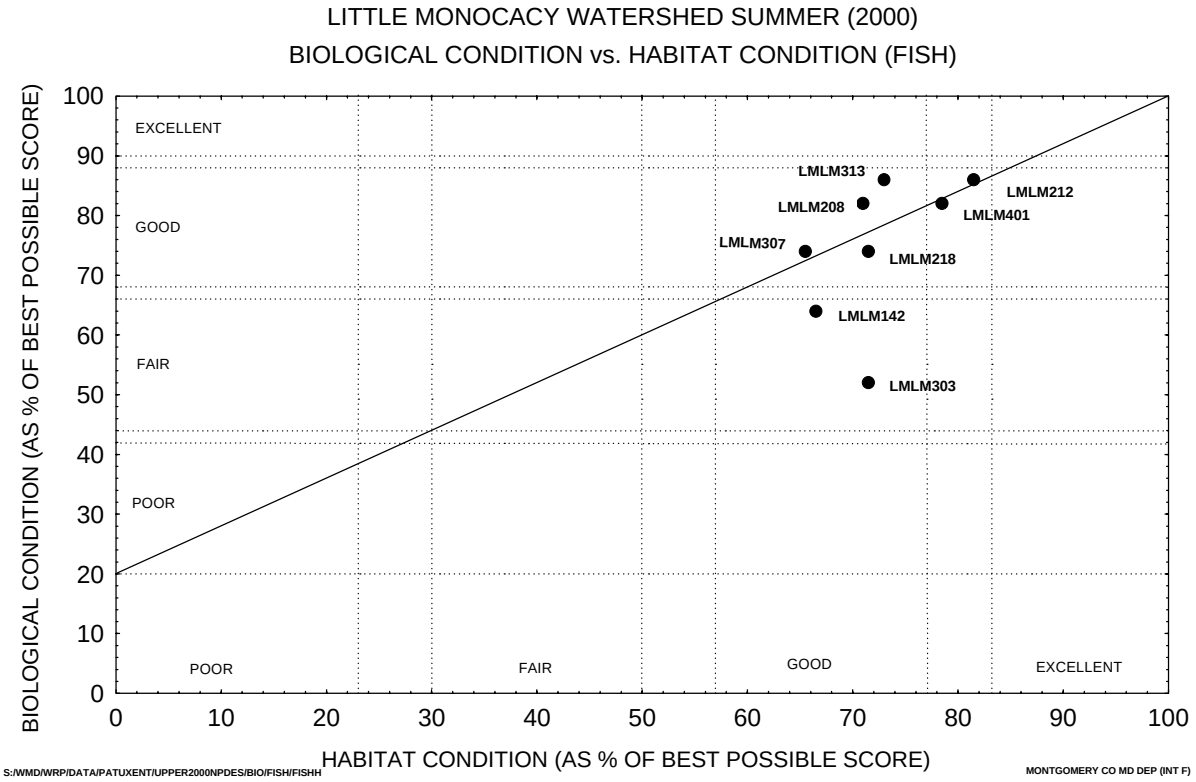


Figure 4. Biological Condition vs. Habitat Condition as Percent for the Best Obtainable Score

Stations of Concern

Stations identified as areas of concern from the IBI/Habitat evaluation are listed in Table 2. These stations were identified because they plotted outside of the range expected habitat/biology relationship for fish or benthics. LMLM142 and LMLM303 showed impairment in the fish community, and LMLM307 showed impairment in the benthic macroinvertebrate community.

Table 2. Stations Considered Areas of Concern.

Monitoring Station	Location	Drainage Area	Benthic IBI	Fish IBI	Recommended Action
LMLM142	Route 28	224 acres	Good (34)	Fair (29)	Examine Sediment Erosion Parameters above and within station.
LMLM303	Harris Road	1763 acres	Good (34)	Fair (23)	Fish Cover Restoration.
LMLM 307	Barnesville Road	5479 acres	Fair (32)	Good (36)	Examine Sediment Erosion and Agricultural Management Plans.

2. Rapid Habitat

Rapid habitat assessments conducted during the benthic macroinvertebrate sampling and fish monitoring scored an overall habitat condition between *good* and *fair*. In the fall, quantitative habitat assessment for LMLM 303 showed an overall *good* habitat quality, while LMLM 142 scored *fair* overall.

Specific habitat parameters were further examined to determine if individual parameters could explain some or all of the impairment observed in the fish and benthic community. Out of our 10 habitat parameters, seven of these are good indicators of impairment from habitat stressors. The remaining three parameters were excluded for the following reasons. Channel alteration (channelization or dredging) is usually absent or minimal in County streams. The scores of bank vegetation protection usually follow those of bank stability (stable banks support a healthy vegetative cover). Finally, most riparian buffers in the County are 12 meters or greater. Scores for these three parameters are usually in the good to excellent range at all monitoring stations.

Table 3. Selected Habitat Parameters (Rapid Habitat Assessment) at Areas of Concern

Monitoring Stations		Fish Cover	Benthic Substrate	Embeddedness	Sediment Deposition	Bank Stability	Flow Status	Riffle Freq.
LMLM142	Spring 4/19	Fair	Excellent	Fair	Fair	Good	Good	Excellent
	Summer 7/20	Excellent	Good	Fair	Fair	Left - Fair Right - Good	Excellent	Good
	Fall 11/06	Good	Good	Good	Fair	Fair	Poor	Good
LMLM303	Spring 4/07	Fair	Good	Good	Good	Good	Good	Good
	Summer 7/06	Fair	Excellent	Good	Good	Good	Fair	Excellent
LMLM307	Spring 4/07	Fair	Good	Good	Fair	Left - Good Right - Fair	Good	Good
	Summer 7/12	Good	Good	Good	Fair	Good	Good	Good

Predominately, most of the habitat parameters scored either a *fair* or *good* rating throughout the monitoring year. Benthic substrate and riffle frequency all scored between *good* and *excellent* condition. Excluding the spring and summer sampling for LMLM303, sediment deposition scored *fair* for all three stations of concern.

According to Table 3, embeddedness, sediment deposition, and bank stability may affect the overall fish and benthic communities the most at LMLM142. This section of stream is fairly small and is located with in a buffer of trees next to farmland. Bank stability scored *fair* to *good*. Unstable banks cause increase sediment deposition and embeddedness to the stream.

LMLM303 is fairly shallow and is surrounded by a large riparian buffer zone. This site scored overall *good* to *excellent* in all parameters except fish cover and channel flow status. Fish cover scored *fair* for both monitoring seasons. In the summer time, channel flow status dropped from good to *fair*.

Overall, biological communities were not affected at LMLM307; however, habitat conditions fell below the expected condition line. Bank stability, fish cover, and sediment deposition contributed to lower habitat scores.

3. Water Quality

Physiochemical parameters measured during the monitoring year at these stations were examined for any indication of impairment from water quality stressors (Table 4). It was noted that in the fall for station LMLM142 there was little or no flow present in the stream. The hydrolab measurements were performed in more of a pool than flowing water. As expected, the water temperature increased from spring to summer. During the summer, dissolved oxygen and percent saturation measured above the 5.10 mg/l and 55.7 % saturation criterion limit for State Water Use Class 1 Waters (COMAR 26.08.01-.04). State Water Use Class 1 Waters also describes normal pH values ranging between 6.5 and 8.5. Our stations in the summer were all within Maryland Department of the Environment's "normal" range. Lastly, the conductivity levels, in the three stations of concern, appear to be under normal natural levels. Overall, there are no water quality parameters affecting the impairment of the stream.

Table 4. Physiochemical Parameters Measured During the Monitoring Year at Areas of Concern

Monitoring Stations		Time of Day	Water Temperature (°C)	Dissolved Oxygen (ppm)	Percent DO (%)	pH	Conductivity (µmhos)
LMLM142	Spring 4/19	13:10	15.13	9.24	91.0	N/A	137
	Summer 7/20	09:28	17.93	6.95	72.1	6.79	200
	Fall 10/06	10:13	7.80	1.70 little-no flow	12.2	6.60	351
LMLM303	Spring 4/7	11:00	12.37	11.62	106.5	7.63	121
	Summer 7/06	10:00	18.78	5.83	62.0	8.20	117
LMLM307	Spring 4/7	13:30	14.05	12.75	121.0	7.92	116
	Summer 7/12	9:30	19.87	7.80	84.0	7.14	132

4. Quantitative Habitat

Quantitative habitat was surveyed during the fall/winter of 2000 for four of the Little Monocacy Stations, LMLM 142, 212, 401, 403. Analysis of these measurements can provide further information to aid in deciding whether or not a habitat limitation, physical impairment, or water quality impairment is potentially influencing the fish and benthic macroinvertebrate communities of the stations of concern. In addition, quantitative habitat data was examined to see any areas of accelerated habitat instability were observed.

To determine whether this stream is entrenched or not one must take the flood prone width and divide it by the bankful width (figure 5). An entrenched stream would have a range between 1.0 to 1.4, while a moderately entrenched would have 1.4 to 2.2, and slightly entrenched stream would have a calculation of greater than 2.2 (Rosgen,

1996). The survey conducted at LMLM142 indicates that this segment is entrenched, 1.15. The flood prone width of this stream was determined to be 12.65 feet and a bankful width of 11.00 feet. An entrenched condition will confine erosive velocities and sediments within the active channel. If the stream were slightly entrenched, floodwaters would expand out into the flood plain and allow fish to escape the high velocity channel currents.

The width/depth ratio is another parameter to understanding the distribution of available energy, with various discharges, occurring within a channel to move sediment. "As the width/depth ratio value increases, i.e., the channel grows wider and more shallow), the hydraulic stress against the banks also increases and bank erosion is accelerated" (Rosgen, 1996). To calculate this ratio, bankful width is divided by mean bankful depth. LMLM142 had a bankful width of 11.00 feet and the mean bankful depth was determined to be 0.75 feet, therefore the ratio was 14.67. The stream received a score of moderate to high, according to Rosgen's chart (1996). This indicates that there is channel instability within this segment of reach.

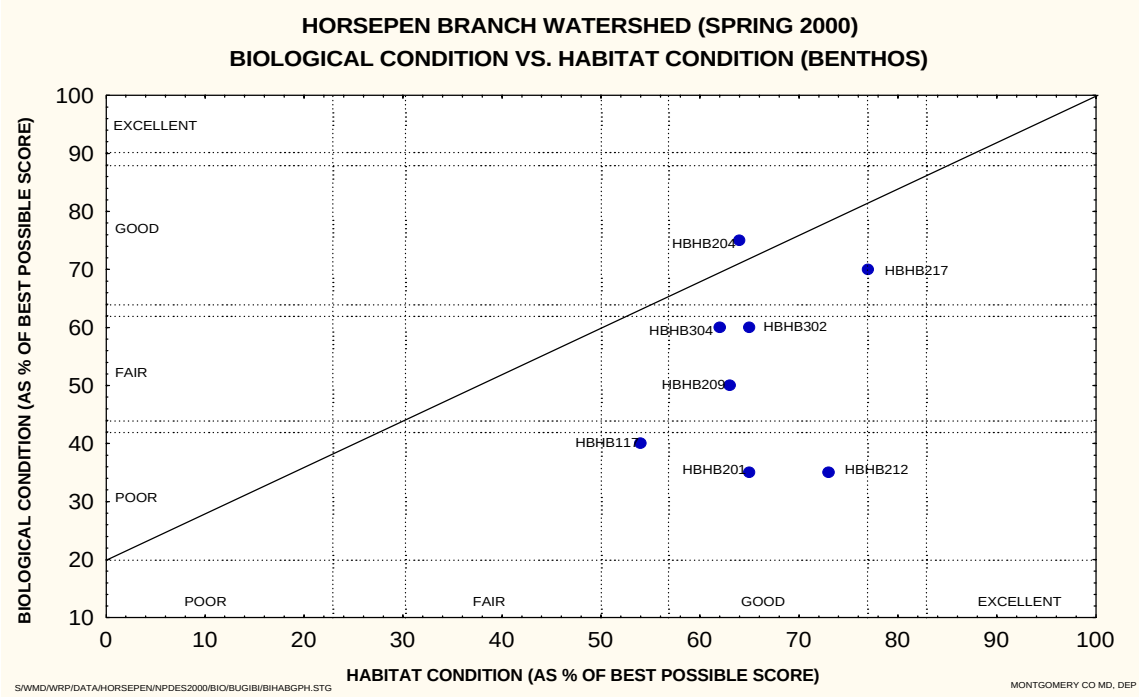


Figure 5. Entrenched Section of Little Monocacy at LMLM142

Riffle substrates were evaluated by conducting pebble counts at all stations. Substrate analysis can determine whether or not particle size may be limiting benthic macroinvertebrate communities. The median (D^{50}) particle distribution was in the fine gravel range for LMLM142. Fine gravel is not ideal for benthic communities, but in this case the benthic community was not affected as much since they scored a *good* biological condition rating. The percent accumulation of pebbles peaked at the expected D^{84}, very coarse gravel. There was a diverse size of particles found in the stream.

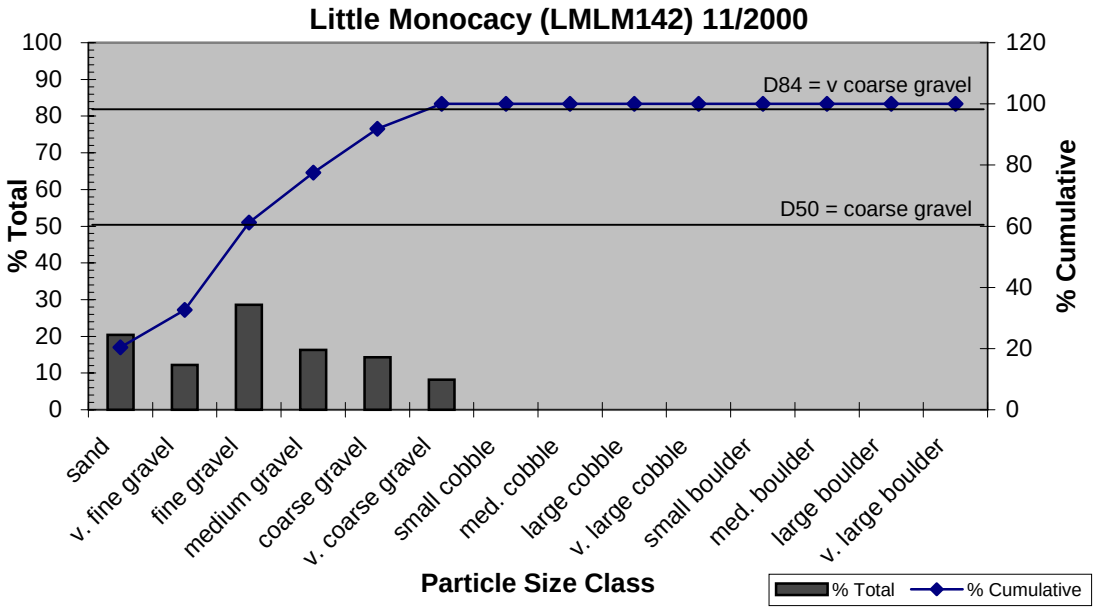


Figure 6. Analysis of Pebble Counts Taken in LMLM142's Riffle Habitat

5. Water Temperature Monitoring

Three continually recording temperature loggers were placed in Little Monocacy from the beginning of June through the end of September 2000 (Figure 6). Temperature readings for all three streams very rarely went above the State of Maryland's Use classification standard for class IV and never went above 27°C (80.6°F). Maryland set regulations that temperatures should be below 90°F (class 1) for Little Monocacy. Out of the three stations of concern, Montgomery County DEP placed a temperature logger in one of them, LMLM 303. This station's temperature did not go above 79°F. Overall, stream temperature does not appear to be a significant limiting factor in the Little Monocacy watershed.

6. Drainage Area

The drainage area is the amount of surrounding area that drains into each portion of the watershed. A drainage area of less than 300 acres is considered to be small. In these smaller drainage areas, there tends to be less flow within the stream. This makes it more difficult for a diverse fish community to survive, and yet a healthy benthic macroinvertebrate community may be seen. LMLM303 and LMLM307, both have large drainage areas and plenty of flow. Site LMLM 142, has a small drainage area of 142 acres. It may be concluded that this may be a limiting factor to the site and the cause for a *low* fish IBI score (Table 2).

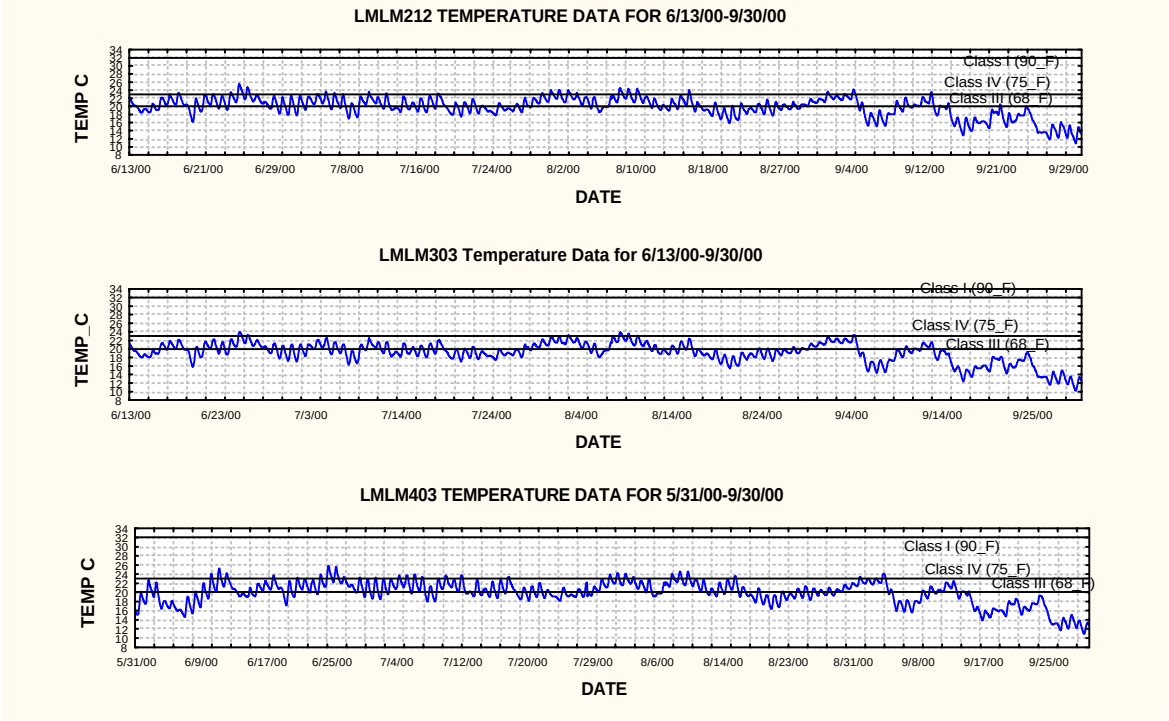


Figure 7. Stream Temperatures in Little Monocacy

V. Discussion

Overall, six of the nine stations monitored in the Little Monocacy watershed in 2000 were overall in *good* health (LMLM208, 218, 212, 313, 401, 403). Two stations (LMLM142, 303) have fish impairment, while one station (LMLM307) has benthic macroinvertebrate impairment.

After reviewing the 2000 monitoring data some of the parameters have not showed significant signs of impairing Little Monocacy. Physical chemistry samples are within COMAR's parameters written by Maryland Department of the Environment. The temperatures recorded in from the beginning of June through the end of September 2000 also did not reveal any hot or cold peaks that may affect the overall biological community.

Drainage area may be a leading factor in the impairment of fish at LMLM142. The total drainage area surrounding this station is below the suitable drainage area by about 100 acres. It was seen to have little or no flow in the fall, resulting in unsuitable habitat for fish. This station also had localized bank instability, which may attribute to embeddedness and sediment deposition. The riparian buffer on both sides of the stream is sufficient and is not a limiting parameter with in the site, although beyond the buffer is active farmland. It was noted that the farmland between the stream and Route 28 was using a practice known as contour farming, which limits the amount of soil erosion. Further examination of upstream riparian buffers is recommended to determine if they are inadequate resulting in sediment deposition.

LMLM303 is surrounded by a large riparian buffer zone on both sides and is a fairly shallow segment of stream. Compared to the spring monitoring, summer channel

flow status dropped from *good* to *fair*. This is expected since the warmer weather increases evaporation. Also, in reviewing the overall parameters, this station was entrenched, confining flood waters within the active channel. This limits the amount of available resources for fish to use to escape the rushing current. Fish cover is a limiting resource within this station. The stream is shallow with limited amount of root wads, submerged logs, or any other stable habitat for fish. This station should be examined for possible fish cover restoration.

Lastly, LMLM307 has habitat impairment that is affecting the benthic macroinvertebrate community. As benthic macroinvertebrates become more impaired, this will negatively affect the fish community, since this is a main source of food. Bank stability and sediment deposition are contributing to the impairment of the benthic community. This station is next to an old pasture field with limited amount of riparian buffer. Further habitat monitoring is recommended within and above this site and possible increase to the riparian buffer width. In addition, the future plans of the old pasture field should be examined. Depended on the future land usage, suggestions from Natural Resource Conservation on agricultural management plans might be necessary to reduce land runoff.

No stations show impairment from other than physical habitat parameters. In conclusion, it is recommended that LMLM142, LMLM303, and LMLM307 all have follow up habitat surveys. LMLM142 and LMLM307 have shown to have a high amount of sediment deposition and LMLM303 is lacking adequate fish cover. With habitat examination and riparian buffer review within and above the sites, these stations should be able to be restored into a healthier state.

VI. Literature Cited

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